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for a statement whether the interests of science required this long extension of the arc, and the Academy has replied, through M. Poincaré, that the arc should be extended to 6° , and that the Academy should exercise a scientific control of the work through a permanent commission, but that the actual work on the ground should be confided to the Geographic Service of the French Army.

The sentiment of the Association was in favor of the prompt execution of this work. It was stated that two officers would shortly leave for South America to finish all preliminary preparations, and that three other officers and their staff would probably start about the last of April, 1901, to take up the field work. A French astronomer is already in charge of the observatory at Quito, under appointment from the Government of Ecuador.

During the discussion of the project for a great meridional arc in Africa, proposed by Sir David Gill, the Astronomer Royal at the Cape of Good Hope, I had occasion to make the following remarks, in response to the request of Professor Darwin for some statement from the delegate of the United States in reference to the suggestion offered by General Bassot, one of the French delegates, that in America there was an opportunity of measuring an arc of the meridian from Cape Horn on the south to the Arctic Ocean on the north :

"In response to the request of M. Darwin, I have the honor of expressing my appreciation and admiration of the grand scheme of triangulation proposed by Professor Gill, Director of the Observatory of the Cape, and take pleasure in stating that the motion for its endorsement by the International Geodetic Association will receive my earnest support. I will present the plan to my government and feel confident that it will receive all possible support from the geodesists of my country.

"In reference to the suggestion of General Bassot that a great meridional arc might be measured in America, I have to state that the United States is now engaged in measuring an arc along the 98th meridian west of

Greenwich, which will extend entirely across the country and cover 23° of latitude.

"The details of the condition of this work at this time will be found in my report to the Association.

"This arc can be extended south 9° of latitude by Mexico, and north by Canada to the limit of ice and snow in the Arctic regions, an unknown distance. I do not think that my Government is prepared to undertake any extension of the above scheme at present."

After discussing Sir David Gill's scheme, the Association indicated its approval by a unanimous vote.

When the report on the new measurement of the Equatorial Arc (known as the Arc of Peru), was before the Association, I took occasion to make the following statement :

"The delegate on the part of the United States desires to express, in the most positive manner, admiration and appreciation of the work already accomplished by the French geodesists, as shown in their report on the reconnaissance of the Arc of the Meridian of Quito, and to extend to them the most cordial congratulations.

"Feeling the deepest interest in the prosecution of the work and in its successful completion, he trusts that no serious obstacle will cause delay.

"Its ultimate completion is assured, now that it has been undertaken by those who will make any necessary sacrifice to add this additional glory to the illustrious position already attained by French geodesists.

"If assistance of any kind is needed to complete the work, he hopes that his country will be given preference in doing all in its power to supply whatever is demanded by the exigencies of the case."

ISAAC WINSTON.

U. S. COAST AND GEODETIC SURVEY.

THE ALBANY MEETING OF THE GEOLOGICAL SOCIETY OF AMERICA.

II.

Stereographic Projection in Map-Construction :

SAMUEL L. PENFIELD, New Haven, Conn.

By means of lantern slides and diagrams, Professor Penfield illustrated the methods of projecting maps of the various parts or countries of the globe upon the plane of its equator or of any other great circle. The methods are those employed by crystallographers for the projection of the polar points

of crystals and possess many advantages over the Mercator's projection or the ordinary maps which are practically pictures without definite mathematical proportions. Professor Penfield has constructed a series of scales which correspond to the projections of arcs by the stereographic method, and which enable one to measure distances between points of the earth whose latitudes and longitudes are known. Great accuracy can be obtained even when the projections are made on a circle whose diameter is less than six inches. The paper appears in the January number of the *American Journal of Science* and should be read by all teachers of geography.

The Paleozoic Limestones of the Kittatinny Valley, N. J.: HENRY B. KÜMMEL, Trenton, N. J., and STUART WELLER, Chicago, Ill.

The Paleozoic limestones of the Kittatinny Valley are divisible into the Kittatinny formation below and the Trenton above. The former is a magnesian limestone, probably 3,000 feet thick, and ranges from lower Cambrian into the Calciferous, with no structural or marked lithological differences. The Trenton limestone, about 135 feet thick, carries in its lower beds the Black River fauna, making it the equivalent of the lower Trenton of New York. A conspicuous and widespread basal conglomerate at the bottom of the Trenton rests upon the eroded surface of the Kittatinny formation. The lithological and faunal characteristics of the formations were described and their structural relations shown. The extent and importance of the basal conglomerate were outlined.

In discussion, M. R. Campbell inquired if the Trenton conglomerate changed in thickness from northwest to southeast. Mr. Kümmel replied that it did not, generally, although there was some variation in that the conglomerate appears to have been

formed at the foot of cliffs. Mr. Campbell stated that he had noted somewhat similar relations in Virginia, but that the conglomerate appeared on the northwest sides of the valleys and not on the southeast. He explained it as due to an interval of erosion and to the direction of the currents. N. S. Shaler cited parallel conditions in Kentucky and remarked the tendency of the limestones to thicken toward the northwest, not only in the Trenton but in the Lower Carboniferous and in the Coal Measures as well. He explained this by an Appalachian island to the eastward. J. M. Clarke mentioned a basal conglomerate in the Trenton near Albany, with fossiliferous pebbles containing a different fauna from the cement. J. F. Kemp cited a conglomerate of boulders of gneiss enclosed in a limestone cement in the thin Trenton outlier, within the southern Adirondack crystallines, at Wellstown, N. Y. The boulders are several inches in diameter, are similar to the neighboring gneisses and have apparently been dropped by floating ice. T. C. Hopkins remarked the Trenton conglomerate of the Nittany Valley, Penn., and its likeness to that of New Jersey.

The Niagara Group along the Western Side of the Cincinnati Anticline: AUG. F. FOERSTE, Dayton, Ohio.

The paper described the lithology, paleontology and physiography of the Niagara Group, with special reference to Middle Tennessee. It was the continuation of an investigation which had been partially described to the Society at a previous meeting, and which had for its object the determination of the time of upheaval and the structural relations of the Cincinnati uplift. Mr. Foerste traced the several component strata from north to south on both sides of the great fold, from Ohio into Central Tennessee, and especially emphasized the excellent section presented at Newsome, Tenn. He

had observed that the Clinton fossils of New York occur at higher and higher horizons as one goes westward, and by this observation he was led to correct some previous errors of correlation. He placed the crest of the fold farther west than is ordinarily done, and made the upheaval later than the close of the Ordovician and earlier than the Hamilton, whose shale goes unconformably over the strata on the flanks.

At the conclusion of the paper the Society adjourned for lunch. On reassembling the program was continued as follows:

The Knoydart Formation in Nova Scotia—a bit of the 'Old Red Sandstone' of Europe: H. M. AMI, Ottawa.

The presence of such genera as *Pteraspis*, *Pterygotus*, *Onchus*, etc., in the red marls, shales and calcareous breccias (?) of McArras Brook in Antigonish and Pictou counties, Nova Scotia, indicates the base of the 'Old Red Sandstone' of Great Britain. The paper discussed the relations, paleontological and stratigraphical, of this important formation in the sequence of Devonian strata in eastern Canada. The result of observations made by Mr. Hugh Plebden, of the Canadian Geological Survey, as published on this subject, together with important notes by Mr. A. Smith Woodward and Dr. Henry Woodward, of the British Museum, was embodied in the paper.

The names applied by Mr. Ami to the several formations of this section are the following:

The Silurian of the Arisaig Coast of Nova Scotia is divisible into at least four distinct geological formations, and includes:

1. *The Stoneham formation*, consisting for the most part of dark red and fine grained shales and mudstones, holding a conspicuous, lamellibranchiate fauna, of which *Grammysia Acadica*, Billings is a well-known species, together with a number of interstratified, more or less thin, calcareous

bands, holding brachiopods, gastropods, trilobites and ostracods in abundance.

2. *The Moydart formation* consisting of more or less heavy bedded, light greenish-gray and rusty weathering, calcareous strata, in which the author's 'Red Stratum' occurs—holding brachiopods, cephalopods, crinoids and gasteropods.

3. *The McAdam formation* consisting for the most part of impure, black, carbonaceous, at times splintery shale, holding a lamellibranchiate fauna, graptolites, etc.

4. *The Arisaig formation* including buff-weathering, fine grained and compact mudstones and shales, holding corals, chiefly *Streptopasma* and brachiopods, gastropods and trilobites.

5. *Knoydart formation* red shales and sandstones and calcareous bands, holding pteraspidian and ostracoderm fishes and crustaceans, referable to the Cornstone or lower Old Red Sandstone of Great Britain. It immediately overlies the Silurian strata at Arisaig, but no actual contact has been observed.

H. S. Williams inquired about the igneous rocks at the top and in further detail regarding the Knoydart formation. Mr. Ami replied that igneous rocks were present. The strata had been mapped as upper Devonian, but that they really were lower Devonian and possessed a pronounced Silurian facies. The whole series is much more closely related to the British fauna than to that of Anticosti.

A Depositional Measure of Unconformity:

CHARLES R. KEYES, Des Moines, Iowa.

The paper was read by W. B. Scott.

The great unconformity at the base of the Coal Measures in the upper Mississippi Valley was briefly characterized in its various aspects. The enormous thickness of Coal Measures in Arkansas and Indian Territory finds adequate explanation in the ancient geographic development. The recent

results of correlation of the north and south regions were summed up. Twenty thousand feet of the Arkansas Coal Measures are found to have been deposited during the period represented by the great stratigraphic break in the north. No discussion.

Marine and Fresh-water Beaches in Ontario.

A. P. COLEMAN, Toronto, Canada.

Marine deposits, often rich in shells and other fossils, are widely distributed east of Brockville and Smith's Falls, in the valleys of the Ottawa and St. Lawrence. They occur at higher levels toward the northeast and east than towards Brockville; they include trees and other forms indicating a climate like that of to-day, and are all evidently postglacial. The shells occur in clay, sand and also coarse gravel.

High beaches, such as the Iroquois, Warren, etc., contain only fresh-water shells, if any. Still higher beaches, such as those reaching 1,400 to 1,600 feet above sea level in the highlands between Georgian Bay and Lake Huron, and the beaches found above 1,400 feet between Lake Superior and Missanabie, and at the same level on the Hudson Bay watershed northwest of Sudbury, have not yet been found to contain shells, although if marine there must have been complete and widely opened connection with the sea. The wide gravel terraces on the watershed mentioned contain numerous and large, kettle-shaped, lake basins, sometimes without outlets, suggesting that they were formed by the burial of large blocks of ice at the border of the Labradorian ice sheet, and hence in ice dammed waters.

In discussion Robert Bell explained the presence of fresh-water shells amid marine conditions because of the forcing back of salt water by an inflowing stream of fresh. On the north side of Lake Superior he cited the occurrence of marine shells up to 500 feet, but their absence in the high gravels.

He argued against the existence of ice dams in the past. G. K. Gilbert described the phenomena along the St. Lawrence east of Lake Ontario. He cited the occurrence of marine shells as far as Ogdensburg. C. H. Hitchcock referred to the sea-shore plants that are found around Lake Superior, apparently left by the withdrawal of the salt water. He also suggested that the basin of Lake Ontario might be due to the removal of limestone in solution. F. B. Taylor discussed the shell-beds, beaches and ice-dams. H. P. Cushing instanced the high gravels and general physiography of the Adirondacks as bearing on the questions. The Adirondacks embrace the high mountains, the western peneplain plateau and the depressed lakes. Kettle-holes occur on the north side but not on the south. Ice dams are proved by the kames left by subglacial streams which flowed against the slope of the country.

The Geology of Rigaud Mountain, Province of Quebec, Canada: OSMOND EDGAR LEROY, Montreal, Can. Introduced by F. D. ADAMS.

The chief topographic feature of the Paleozoic plain of Central Canada is a series of hills, which occur in the district about Montreal. These are of igneous origin, and follow a line of disturbance which is almost at right angles to the trend of the Notre Dame Mountains. Rigaud is the most western of the series. It consists of an area of hornblende syenite, which is pierced on its northern flank by a quartz syenite porphyry. The field relations of all the hills with the exception of Rigaud, show them to be of post-Silurian age. In the case of the latter, the contact with the Paleozoic is wholly concealed by drift. The object of the research was to ascertain if a genetic connection could be established between Rigaud and the other hills to the east.

Investigation shows that it is probably

not so connected, but a definite conclusion cannot be reached until a more extended study is made of the rest of the range.

In discussion, F. D. Adams commented on the interest attaching to this mountain both in its petrographic and stratigraphic relations. Mention was made by others of the benches of boulders which lie on the side of Rigaud. It was brought out that they are coarse cobbles, entirely unglaciated and all of local origin. They are known as the Devil's Garden and are at least thirty feet deep, but have no fine material between them. N. S. Shaler, therefore, remarked that they could not be beach-deposits, else they would be packed with sand. The interpretation of the boulders is an interesting point in post-glacial geology, but it still remains to be solved. J. F. Kemp remarked the similarity of the syenite to that of the Adirondacks, especially as described by H. P. Cushing in an earlier paper.

At the conclusion of Mr. Leroy's paper the session adjourned.

In the evening the Society was most hospitably entertained by Dr. and Mrs. F. J. H. Merrill and had the opportunity of meeting many Albany people.

On reconvening on Saturday morning the most important executive business was the adoption of a resolution recommended by the Council, which read as follows :

Resolved, That recognizing the great, historical, scientific and economic value of the collections of the State Museum in Albany, representing the geology and paleontology of the State of New York, the Geological Society of America expresses the earnest hope that an ample and fireproof building may be provided for the display of the priceless collections, where they may be accessible to students interested in the progress of science and the economic development of the State.

The Society then listened to the Presi-

dential address of Dr. George M. Dawson, who took for his subject 'The Geological Record of the Rocky Mountain Region.' The paper was illustrated by maps and by comparative stratigraphic sections both east and west of the Canadian Rockies. It dealt especially with Canada and will be probably printed in full in a later number of *SCIENCE*.

The following paper was read in abstract by G. P. Merrill.

Weathering of the Granitic Rocks of Georgia :

THOMAS L. WATSON, Atlanta, Ga.

The paper embraces the results of a detailed field and laboratory study of the principal exposures of the granitic rocks in Georgia. On structural and textural grounds, the rocks were divided into and discussed under (a) the true granites with even-grain texture; (b) porphyritic granites; and (c) granite-gneisses. Each type, as here distinguished, is represented by a number of localities in somewhat widely separated parts of the State. In mineral and chemical composition, the rocks are closely similar, and all carry biotite as the chief accessory.

The physical conditions of the fresh rock and of its accompanying, decayed product as studied in the field were carefully stated, and each was described petrographically, the description being followed by a discussion, based on chemical analyses, of the changes incident upon weathering.

In taking up the changes manifested in the weathering of the rocks, as shown in the analyses, calculated amounts of each constituent lost and saved were separately made on three assumptions, namely, that the Fe_2O_3 , the Al_2O_3 and the $Fe_2O_3 + Al_2O_3$ have undergone no loss. The results were then compared. With the exception of the total loss for the entire rock, the results proved to be closely similar for the three assumptions.

The Peneplain of Brittany : W. M. DAVIS, Cambridge, Mass.

The paper consisted of an exhibition of lantern slides illustrating the peneplain of Brittany, and of its detached portions in Jersey and Belle Isle, as well as of certain valleys by which the peneplain has been dissected since its elevation; and of comments in which the speaker argued that the plain was not one of marine denudation, but was subaërial.

The paper led to a quite extended discussion of the criteria for plains of marine origin, chiefly emphasized by N. S. Shaler and H. M. Ami, and of those of subaërial character, as developed by C. D. Walcott and G. K. Gilbert.

An Excursion to Colorado Canyon: W. M. DAVIS, Cambridge, Mass.

Observations made in the canyon of the Colorado and over the plateaus on the north and south, during a three weeks' trip in June, 1900, add the occurrence of certain landslides and migrating divides to the evidence already stated by Dutton in favor of two cycles of erosion in the development of the Grand Canyon district; the broad denudation of the plateaus having been accomplished in the first cycle, and the incision of the narrow canyons in the second. The faults by which the plateaus are divided are regarded as for the most part of greater antiquity than the canyon cycle; the antecedent origin of all the branch streams of the Colorado in this district is questioned; and the high level floor of the Toroweap valley is explained otherwise than by the failure of its former water supply through a change from a humid to an arid climate.

G. K. Gilbert corroborated the probability of the speaker's views from the evidence of neighboring systems of drainage, and C. D. Walcott spoke in the same vein.

Fossiliferous Layers in the Calciferous of Dutchess County, N. Y.: W. B. DWIGHT, Poughkeepsie, N. Y.

The paper described some recent discov-

eries of a Calciferous fauna, somewhat related to the Fort Cassin fauna of Vermont. It seems to identify the Calciferous for the first time so far south. It contains 24 species, of which 9 are trilobites.

C. D. Walcott remarked its resemblance to the fauna at Phillipsburg, Vt., and to another at Eureka, Nev.

Glacial Phenomena in Eastern Ontario: F. B. TAYLOR.

The speaker described the results of his observations of the moraines and other glacial phenomena in the portion of Ontario lying between Georgian Bay and Lake Ontario. At least four moraines can be identified which he endeavored to trace out to a connection with those further south. He also described an old river channel near Guelph which had been produced by a stream flowing against the front of the ice sheet.

The paper was discussed by W. M. Davis and A. P. Coleman. The former emphasized the importance of accurate phraseology in the nomenclature of glacial forms, the latter corroborated the general conclusions of Mr. Taylor in respect to the local geology.

Biserial Development in the Plates of the Arms of Crinoids: A. GRABAU, Troy, N. Y.

By means of a series of diagrams the speaker showed how the arms of crinoids begin with a uniserial set of plates, and then by the development of a series of wedge-shaped plates gradually become biserial.

The Atchison Deep Well, Kansas: E. HAWORTH, Lawrence, Kansas.

The paper was read in abstract by J. F. Kemp in the absence of the author. It described a recent deep well at Atcheson which revealed two workable coal-seams and which threw new light on the structural relation of the Coal Measures and Lower Carboniferous strata in this section.

The following papers were read by title: *Sand Crystals and their Relation to certain Concretionary Forms*: ERWIN H. BARBOUR, Lincoln, Nebr.

The Broad Valleys of the Cordilleras of North America: N. S. SHAHER, Cambridge, Mass.

Keewatin of Eastern Central Minnesota:

Keewenawan of Eastern Central Minnesota: C. W. HALL, Minneapolis, Minn.

Points Involved in the Silurian-Devonian Boundary Questions: H. S. Williams, New Haven, Conn.

Age of the Coals at Tipton, Blair Co., Pa.: DAVID WHITE, Washington, D. C.

Comparison between the Stratigraphy of the Black Hills and that of the Front Ranges of the Rocky Mountains: N. H. DARTON, Washington, D. C.

Tertiary History of the Black Hills: N. H. DARTON, Washington, D. C.

The Wisconsin Shore of Lake Superior: G. S. COLLIE, Beloit, Wis.

Landslides of the Echo and Vermilion Cliffs, Grand Canyon of the Colorado: RICHARD E. DODGE, New York City.

The Society then passed the customary votes of thanks to the local Fellows and with them closed a very successful meeting.

J. F. KEMP.

COLUMBIA UNIVERSITY.

ANTHROPOLOGY AT BALTIMORE.

SECTION H of the American Association for the Advancement of Science held its winter meeting at Baltimore, Maryland, on December 27th and 28th, in conjunction with the meetings of the American Society of Naturalists and Affiliated Societies.

Vice-President Butler being unavoidably absent, Professor Franz Boas was elected temporary chairman at the Thursday morning session which was called to order at

10.15 o'clock in the Historical Seminary Room at Johns Hopkins University.

The first paper read was by Dr. Thomas Wilson, on 'Anthropological Congresses at the Paris Exposition of 1900.' After a brief sketch of the history of the Congrès International d'Anthropologie et d'Archéologie Préhistorique, Dr. Wilson gave a summary of the work done at the recent sessions at Paris and described the field excursion. An account was also given of the meeting of the Congrès International des Américanistes. This Society has accepted the invitation to meet in New York city in 1902. On the motion of Dr. Wilson a committee of three was appointed to take preliminary steps for the reception of the Congress at this, its first meeting in the United States. The committee appointed consists of F. W. Putman, chairman, J. W. Powell and G. A. Dorsey.

The next paper, entitled, 'The McCormick Expedition among the Hopi,' by Dr. G. A. Dorsey, described the archeological work done along the Little Colorado River by a party from the Field Columbian Museum and by another party in the vicinity of the Hopi pueblos. The ethnological work of Mr. Voth was also described and commended. This paper will be published in SCIENCE.

Professor Franz Boas next spoke of the desirability of a catalogue of the crania now in American museums. In order that the various collections may be worked up in a uniform manner, standard skulls should be sent to each museum from which the measurements to be taken might be learned and the extent of error in observation reduced to a minimum. The Section was unanimous in its approval of Professor Boas's plan and it was voted to refer the preparation of a report upon osteological cataloguing to the Anthropometrical Committee of the Association.

Dr. Frank Russell then demonstrated a